REMARKS

Status of claims

Claims 1-20 are currently pending in the application. Claim 1 has been amended to at least correct an error that was pointed out by the Examiner in the rejection under 35 USC 112. Claims 2 and 6 have been cancelled. Claims 3-5 and 7-10 have been amended to clarify that the sensor is performing the determining or measuring. Claim 11 has been amended to add the limitation "in real time," and to specify that the variable transmission mask is positioned above a mask or a reticle having a pattern imprinted thereon. Claim 16 has likewise been amended to specify that the variable transmission mask is positioned above such a mask or reticle. Claims 12-15 and 17-20 remain unchanged.

Objection to the specification

The specification has been objected to because of an error in the reference number after the term "mask adjuster" on page 13, lines 1-2. The reference number "326" has been corrected as the reference number "324," and Applicant requests that this objection be withdrawn.

Objection to the drawings

The drawings have been objected to because the structure in claim 6, "wherein the variable transmission mask comprises a sensor" must be shown in the drawings or cancelled from the claims. Claim 6 has been cancelled, thus rendering this objection moot.

Objection to the claims

Claim 6 has been objected to because the specification nor the drawings support claim language in which "the variable transmission mask comprises a sensor." Claim 6 has been cancelled, thus rendering this objection moot.

Claim rejections under 35 USC 112

Claims 1-20 have been rejected under 35 USC 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention. The Examiner has grouped the claims in nine different groups, with a separate rejection pertaining to each group. Applicant likewise responds to the rejection of each group.

Claims 1, 6, and 10

Claims 1, 6, and 10 have been rejected because the specification does not disclose how a "variable transmission mask" can measure focus either indirectly or directly. Applicant sincerely apologizes for this error, and has amended these claims such that it is a sensor that measures focus, and not the variable transmission mask.

Claims 1-5, 11, and 16

Claims 1-5, 11, and 16 have been rejected because the specification does not disclose how a "variable transmission mask" adjusts the focus of the exposure system, in that the specification specifically does not disclose how adjusting the intensity of light transmitted through the mask will in any way adjust the focus of the exposure system. Applicant respectfully disagrees, and traverses this rejection under 35 USC 112. Applicant notes as a general matter that the specification only needs to be enabling to one of ordinary skill within the art, and that which is known within the art does not have to be described in detail, and is in fact best omitted from the specification.

First, in the summary section of the detailed description, it is noted that:

> [A]s the lens of the exposure and alignment unit heats up, the focus of the mask on the semiconductor wafer drifts. This is detected . . ., and in response the mask darkens, or otherwise reduces the transmission of light therethrough, *maintaining the focus*. Thus, *reducing the transmission of light through the variable transmission mask compensates for . . . the focus drift that this heating causes.*

Thus, the specification does in fact describe how adjusting the intensity of light transmitted through the mask adjusts the focus of the exposure system. Particularly, the specification notes that *reducing* the transmission of light through the mask compensates for focus drift. This is how light intensity adjustment affects focus.

Second, Applicant submits that the Examiner himself has cited prior art, Tsukuda (6,333,780) that the Examiner says discloses a liquid crystal display (LCD) that "can control both the intensity and phase passing through, thereby to optimize the resolution and depth of *focus*." That is, as a matter of general scientific principle, it is known within the art that controlling the intensity of light affects focus. Therefore, Applicant does not have to provide the specific scientific theory or details as to *why* controlling light intensity affects focus, but only has to disclose how to make and use the invention – which is accomplished in the specification by simply noting that reducing the transmission of light through the variable transmission mask compensates for focus drift.

Applicant also notes in this regard that an inventor need not comprehend the scientific principles upon which the practical effectiveness of the invention rests. Section 112 does not require a statement of such scientific theory. (Fromson v. Advance Offset Plate, Inc., 720 F.2d 1565, 219 USPQ 1137 (Fed. Cir. 1983)) It is not a requirement of patentability that an inventor correctly set forth, or even know, why the invention works. (Newman v. Quigg, 877 F.2d 1575, 11 USPQ2d 1340 (Fed. Cir. 1989)) Thus, the details as to why controlling light intensity affects focus are properly left out of the specification, and the omission of such details does not render claims 1-5, 11, and 16 non-enabling.

Claim 9

Claim 9 has been rejected because the specification does not disclose how a "variable transmission mask" can measure focus. As with claims 1, 6, and 10, Applicant sincerely apologizes for this error, and has amended claim 9 so that it is a sensor that measures focus, and not the variable transmission mask.

Claims 11, 12, and 15

Claims 11, 12, and 15 have been rejected because the specification and the drawings do not disclose how a "sensor" can be used to indirectly measure focus. The Examiner notes that the specification states that the "sensor 322, which is depicted in FIG. 3, is communicatively coupled to the mask 308," and the drawings show that the sensor 322 is not in the optical path of the light, such that the Examiner has concluded the specification and the drawings do not disclose how such a sensor out of the optical path of light can be used to indirectly measure focus. Applicant respectfully disagrees, and traverses this rejection.

Applicant submits that the Examiner has not read the specification in its entirety, which describes how such a sensor can be used to indirectly measure focus, even when out of the optical path of light. Specifically, the specification, at the end of the paragraph that the Examiner partially excerpted, says that "the sensor may measure heat of the lens 304 to indirectly detect focus drift." Furthermore, the background section of the specification notes that:

> One of the causes of focus drift over time is the heat subjected on the lens from the light source. As heat builds up on the lens, the focus of the lens can sufficiently change to affect the process window for the critical dimensions of the semiconductor device being fabricated.

Thus, a sensor not in the optical path of light can nevertheless indirectly measure focus, by directly measuring heat. In FIG. 3, the sensor 322 is shown as connecting to the variable transmission mask 308, such that it is able to measure the heat of the mask 308 subjected from the light 306 of the light source 304. In this way, the sensor of claims 11, 12, and 15 as indirectly measuring focus is enabled by the specification. Applicant strongly but respectfully suggests to the Examiner that this rejection would not be sustained on appeal.

Furthermore, a sensor by definition and inherently senses, detects, or measures something. Sensors for detecting heat are known within the art, as can be appreciated by the Examiner. Applicant has explained in the specification the relationship between heat and focus. Therefore, since the application need not and best not describe that which is already known, the specification is enabling as to claims 11, 12, and 15.

Claim 14

Claim 14 has been rejected because the specification and the drawings do not disclose how a "sensor" could be used to directly measure focus. The Examiner has concluded the specification and the drawings do not disclose how the sensor 322 depicted in FIG. 3, which is out of the optical path of light, could be used to directly measure focus. Applicant respectfully disagrees, and traverses this rejection.

Applicant submits that the Examiner has not read the specification in its entirety, which describes how a sensor can be used to directly measure focus. Specifically, Applicant notes that excerpt of the specification relied upon by the Examiner in fact complete says that the sensor 322 is depicted in FIG. 3 as "communicatively coupled to the mask 308, *although it can be positioned elsewhere within the system 300, too.*" (emphasis added) A sentence later, the specification says that "the sensor 322 . . . may directly measure focus to detect focus drift." For instance, sensors are commonly placed in the optical path of light, as known to those of ordinary skill within the art, to be able to detect focus.

Therefore, inasmuch as the specification says that the sensor 322 may be positioned elsewhere within the system 300, and that the sensor 322 may directly measure focus, Applicant submits that the sensor of claim 14 as directly measuring focus is clearly enabled by the specification. Applicant strongly but respectfully suggests to the Examiner that this rejection would not be sustained on appeal.

Furthermore, a sensor by definition and inherently senses, detects, or measures something. Sensors for detecting focus are known within the art, as can be appreciated by the Examiner. Therefore, since the application need not and best not describe that which is already known, the specification is enabling as to claim 14.

Claims 16, 19, and 20

Claims 16, 19, and 20 set forth a method for indirectly measuring focus, and have been rejected by the Examiner because the specification does not disclose a method that can measure focus either indirectly or directly. However, the method of claims 16, 19, and 20 is clearly

depicted in FIG. 4 of the drawings, and FIG. 4 is clearly described in the specification. The Examiner has not explained *why* claims 16, 19, and 20 would not be enabling to one of ordinary skill within the art, except for saying "as above." However, claims 11, 12, and 15, and claim 14, deal with whether or not a *sensor* can directly or indirectly measure focus, whereas claims 16, 19, and 20 have no such limitation. The discussion as to whether there is enablement for a sensor that can directly or indirectly measure focus is thus not the same as to whether there is enablement for directly or indirectly measuring focus, period. Therefore, the Examiner has failed to provide a *prima facie* case of non-enablement as to claims 16, 19, and 20. Without one or more specific reasons as to why FIG. 4 of the drawings and its conjoining description in the specification fail to enable one of ordinary skill within the art to make and use the invention of claims 16, 19, and 20, these claims are presumed to be enabled. Applicant again strongly suggests to the Examiner that this rejection would not be sustained on appeal.

Claims 2-10

Claims 2-10 have been rejected because they depend from claim 1 and therefore include the deficiencies of claim 1. Since Applicant has overcome the deficiencies of claim 1, as described above, Applicant submits that the deficiencies of claims 2-10 have been similarly overcome.

Claims 12-15

Claims 12-15 have been rejected because they depend from claim 11 and therefore include the deficiencies of claim 11. Since Applicant has overcome the deficiencies of claim 11, as described above, Applicant submits that the deficiencies of claims 12-15 have been similarly overcome.

Claims 17-20

Claims 17-20 have been rejected because they depend from claim 16 and therefore include the deficiencies of claim 16. Since Applicant has overcome the deficiencies of claim 16, as described above, Applicant submits that the deficiencies of claims 17-20 have been similarly overcome.

Claim rejections under 35 USC 102

Claims 1-6, 9-11, 14-16, 19, and 20 have been rejected under 35 USC 102(e) as being anticipated by Lin (6,486,939). Claims 1, 11, and 16 are independent claims, from which the remaining pending claims depend. Therefore, Applicant particularly discusses the patentability of claims 1, 11, and 16, insofar as these claims are not rendered unpatentable by Lin, such that the other pending claims are patentable for at least this reason.

Claims 1, 11, and 16 share some essentially common limitations that are not anticipated by Lin. Claim 1 has been amended to include a variable transmission mask "that normally has a substantially high transmission of light rating that can be adjusted downward in real time to adjust focus." Claim 11 includes a variable transmission mask "normally having a substantially high but adjustable transmission of light rating." Claim 11 also has been amended to include a mask adjuster "to adjust the transmission of light rating downward in real time to adjust the focus." Claim 16 includes "adjusting in real time a transmission of light rating of a variable transmission mask . . . to adjust focus." In addition, all of the claims 1, 11, and 16 are limited to the variable transmission mask being positioned above another "mask or a reticle that has a pattern imprinted thereon." Applicant submits that these limitations of claims 1, 11, and 16 are not anticipated by Lin.

The mask TM of Yin corresponds to a traditional, optionally phase-shift, pattern mask or reticle to imprint a pattern onto a semiconductor wafer. Whereas a traditional mask is static in that it has an unchanging semiconductor pattern to be imprinted on the semiconductor wafer, the mask of Yin is a dynamic mask, such that different patterns can be imprinted on the wafer using the same mask. Yin specifically notes that:

> [P]ixel units of the SLM mask TM can be switched ON and OFF to form a semiconductor circuit pattern on the matrix of the SLM mask TM. The pixels can also contain phase information which is controlled by computer processors such a 0 phase passes through the SLM mask TM or a 180 phase passes through the SLM mask TM.
>
> . . .
>
> Every pixel of the matrix of mask TM is switched ON (light: "1") or OFF (dark: "0") in response to signals on x and y matrix lines. The binary ON/OFF ("1"/"0") signals provide transmissive or opaque regions in the matrix through which beam LB is projected using a transmissive universal dynamic mask TM formed for example by a Spatial Light Modulator (SLM).
>
> A circuit layout made by a designer . . . is transferred . . . into the control lines 34 of the transmissive universal dynamic SLM mask TM by appropriately turning the pixels "ON" and/or "OFF" in the appropriate locations to form each pattern desired as a function of time as different workpieces are loaded on the stage ST.
>
> . . .
>
> When a different layer is exposed, it is not necessary to reload the mask TM mechanically, only load the device/layer file through the CPU to the mask TM.
>
> The whole device uses the same physical mask TM . . . and there is no mechanical movement of the mask TM . . . .

(Col. 3, ll. 29-34; col. 5, ll. 1-13, 48-52) Thus, in a conventional process, a different photomask or phase-shift mask having a different pattern is used for each "work piece," whereas in the mask of Yin, the same mask is used, but is dynamically programmed such that its pattern varies for each "work piece." The purpose of the mask of Yin, however, is the same in that the mask TM is meant to impart a pattern onto a semiconductor wafer. As such, the mask TM of Yin corresponds to a pattern mask or reticle.

Therefore, the mask TM of Yin, if anything, corresponds to the "mask or reticle having a pattern imprinted thereon" of claims 1, 11, and 16, and not the variable transmission mask of these claims. Like a mask or a reticle having a pattern imprinted thereon, the mask TM of Yin is used to imprint a pattern onto a semiconductor wafer, such as on photoresist of a semiconductor wafer, in a conventional or phase-shift photolithography process. However, if the mask TM of Yin anticipates the mask or reticle limitation of claims 1, 11, and 16, it cannot also anticipate the variable transmission mask limitation of these claims. Claims 1, 11, and 16 now specify two

masks, the mask or reticle, and the variable transmission mask. Yin only specifies one mask, and thus cannot anticipate claims 1, 11, and 16.

Furthermore, and perhaps more significantly, the transmission of light rating of the mask TM of Yin is not adjusted downward in real time to adjust focus, in contradistinction to the invention of claims 1, 11, and 16. Claims 1, 11, and 16 are limited to adjusting the transmission of light rating of a variable transmission mask downward and in real-time, to adjust or maintain focus. The transmission of light rating of the mask TM of Yin is not adjusted downward, nor in real time, to adjust focus. Rather, the individual pixels of the mask TM are selectively adjusted before light is transmitted to each work piece, so that the pattern to be imprinted on a given work piece is programmed into the mask TM before the light is turned on and transmitted through the mask TM and onto the work piece. Once the work piece is positioned and the light transmitted through the already programmed mask TM, there is no further adjustment of the transmission of light rating of the mask to adjust focus – that is, there is no adjustment in real time. Furthermore, there is no motivation to adjust all the pixels of the mask TM in real time to adjust the transmission of light rating of the mask as a whole, as in the claimed invention, because the purpose of the mask TM of Yin is not to adjust or maintain focus, but rather to have a specific pattern programmed therein to be imprinted on a work piece. As such, Yin does not anticipate nor render obvious the claimed invention of claims 1, 11, and 16.

The Examiner seems to suggest that various excerpts of Yin anticipate the focus-adjusting aspect of the variable transmission mask of claims 1, 11, and 16. For instance, Yin states that the "mask TM can work as a phase-shifting mask to enhance the depth of focus of semiconductor circuit printing." (Col. 3, ll. 36-39) However, a phase-shift mask, as known within the art, is a special type of mask that still contains a pattern imprinted thereon and that is used to imprint the pattern onto a semiconductor wafer. The phase-shift properties of the mask enable a better depth of focus to be realized on the semiconductor wafer. This is different than the claimed invention. In the claimed invention, the goal is not to enhance depth of focus for a given pattern on a phase-shift mask, but rather to adjust focus when it is out of specification by adjusting the transmission of light rating of the whole mask downward in real time.

Yin's mask never has its transmission of light rating of the whole mask adjusted, as opposed to selective pixels of the pixel being adjusted in correspondence with a particular semiconductor pattern. Nor does Yin's mask have its transmission of light rating adjusted downward to adjust focus – Yin is silent as to how transmission of light must be adjusted to adjust focus. Finally, Yin's mask does not have its transmission of light rating adjusted in real time. A specific pattern is programmed into the mask, albeit one that can be a phase-shift mask for enhanced focus, and then is used. Between programmings of the mask for different work pieces, Yin's mask is never adjusted in real time to adjust focus while the current pattern of the mask is being imprinted on a given work piece. As before, if anything, Yin's mask corresponds to the mask or reticle having a pattern imprinted thereon of claims 1, 11, and 16, and not the variable transmission mask of these claims.

As another example, Yin states that "[u]sing this CCD image, one can set criteria to determine an optimum focus of the lens module and optimum stage leveling of the exposure tool ET of FIG. 1." (Col. 6, ll. 13-15) However, this excerpt of Yin seemingly determines the optimum focus before a semiconductor wafer is even placed on the stage – hence the CCD image being used to determine the optimum focus. Once optimum focus has been determined, there is no suggestion in Yin that it is modified in real time, nor by adjusting the transmission of light rating of the mask TM, to adjust or maintain focus, as in the invention of claims 1, 11, and 16.

By comparison, the invention of claims 1, 11, and 16 is used to adjust focus in real time, to, for example, maintain the focus that may have initially be determined by Yin. Thus, the system of Yin does not anticipate, but is complementary, to the claimed invention. The mask TM of Yin could be used, if anything, as the mask or reticle of the claimed invention, so that different masks and reticles with different patterns do not continually have to be loaded, but rather the mask TM can be programmed with the different patterns. However, the mask TM of Yin does not have, nor is it obvious to modify to yield, a variable transmission mask (1) in addition to a mask or a reticle having a pattern imprinted thereon, that has (2) a substantially high transmission of light rating that (3) can be adjusted downward to adjust focus (4) in real time. The teachings and disclosure of Yin are very different than the invention of claims 1, 11, and 16, and Yin does not anticipate nor render obvious these claims. Applicant is very much

willing to discuss this with the Examiner over the telephone if any of the foregoing is unclear, as Applicant believes very strongly in the patentability of the invention in view of Yin.

Claim rejections under 35 USC 103

Claims 7, 8, 12, 13, 17, and 18 have been rejected under 35 USC 103(a) as being unpatentable over Lin in view of Nishi (5,883,704). However, because these claims are dependent claims ultimately depending from either claim 1, 11, or 16, they are patentable for at least the same reasons that claims 1, 11, and 16 are patentable, as has already been discussed by Applicant.

Conclusion

Applicant has made a diligent effort to place the pending claims in condition for allowance, and request that they so be allowed. However, should there remain unresolved issues that require adverse action, it is respectfully requested that the Examiner telephone Randy Tung, Applicant's Attorney, at 248-540-4040, so that such issues may be resolved as expeditiously as possible. For these reasons, this application is now considered to be in condition for allowance and such action is earnestly solicited.

Respectfully Submitted,

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